SCR Catalyst Management Strategies – Modeling and Experience

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Summary

For coal-fired boilers equipped with SCR, catalyst contributes to a major operating expense. Strategies for minimizing catalyst cost while preserving system performance - generally referred to as catalyst management – are receiving greater attention. Approaches to managing catalyst can vary widely. Therefore, analysis of catalyst management strategies requires accurate predictive tools for assessing SCR system performance that have the flexibility to address a wide range of scenarios. These predictive tools may also be used to investigate performance issues that facility operators may encounter. However, until recently, operators have not had access to these tools, except through catalyst suppliers or consultants.

In this presentation, various catalyst management strategies will be examined. Using an analysis tool currently used by several power plant operators and SCR technology suppliers, we will illustrate the important considerations of a catalyst management strategy. Comparisons of model results to measured SCR performance at operating facilities will be presented.

Introduction

A comprehensive approach to catalyst management goes far beyond simply planning for the next catalyst addition or replacement and performing the associated catalyst testing. A comprehensive approach extends beyond the simple objective of minimizing catalyst consumption over the plant lifetime. A comprehensive catalyst planning effort involves minimizing the catalyst costs while simultaneously optimizing the operation of the facility to achieve the lowest cost to produce power. As a result, it involves making trade-offs between catalyst consumption, the frequency and duration of outages taken for catalyst work, ammonia slip, NOx reduction, baseline NOx, parasitic pressure loss, and, of course, comparing catalyst regeneration versus catalyst replacement. Assessing these many trade-offs in an efficient manner requires an interactive tool.

Assessing Strategies

Analyzing the various trade-offs and approaches to catalyst management is best done with a computational modeling tool that can quickly estimate the effects of a different approach on facility operation and forecast the future sequence of events and the associated costs. As a result, the model needs to be both accurate and flexible. In this effort, we assessed the possible future strategies for Orlando Utilities Stanton #2 with a software tool called CAT MANAGER™. CAT MANAGER™ is a software tool that runs in Microsoft Excel that has been licensed to utilities and to SCR technology suppliers.

OUC Stanton

Stanton #2 experienced higher than expected catalyst deactivation from arsenic poisoning due to insufficient CaO in the coal ash to scavenge gaseous arsenic. OUC, therefore, has had to install more new catalyst in the Stanton #2 SCR than originally planned and has revised the maximum

ammonia slip to 4 ppm to maintain a three-year replacement interval. For this reason, OUC is evaluating future alternatives to minimize catalyst costs. All decisions thus far have been made by OUC with advice of the catalyst supplier. Using an independent software tool may uncover other cost-effective solutions.

Benchmarking CAT MANAGER™ predictions against measured ammonia slip and catalyst deactivation showed good correspondence. Therefore, modeling of future possible scenarios was undertaken next. Using CAT MANAGER™ five possible future strategies were evaluated – two replacement cases, and three regeneration cases.

The modeling indicated that OUC could potentially stay on a three-year replacement frequency while replacing 185 cubic meters of catalyst instead of 231 cubic meters while keeping ammonia slip below or close to 4 ppm. The Regeneration to 100% catalyst activity would require more frequent catalyst replacements – a three-year outage schedule was not possible - and more total catalyst volume regenerated than would otherwise be replaced. However, depending upon the cost of regeneration, this might be an attractive alternative. Regeneration to only 95% of the original activity would entail more frequent catalyst changes.

CONCLUSIONS

In this presentation we describe some features of a software tool that can help operators make decisions regarding catalyst management. We also discussed how at OUC Stanton it was necessary to modify the catalyst management plan because actual operating conditions and catalyst behavior were not as originally planned. Projections of possible future catalyst management scenarios were made with a software tool that was developed for this purpose. The following are key points.

- Catalyst management involves optimizing a wide range of parameters in addition to catalyst usage. Having a software tool to quickly evaluate different scenarios is very useful.
- Because of the many factors to consider, the most cost-effective catalyst management approach may not be the one that results in the lowest amount of catalyst usage or amount of catalyst regeneration over the period. Other factors, such as the cost of lost production during outages, cost of parasitic power and other effects need to be considered.
- In some cases operating conditions and catalyst behavior will differ somewhat from the actual predictions and it will then be necessary to reevaluate catalyst management options. This is what happened at OUC Stanton. In these situations a tool for evaluating future scenarios for catalyst management based upon the new information is very useful for SCR operators
- A catalyst management tool that is licensed by OUC and others was benchmarked against actual data and provided reasonable correspondence with measured performance.
- Modeling of possible future catalyst management scenarios for OUC Stanton was performed. Scenarios that were assessed included future replacement of catalyst, future regeneration of catalyst, and variations of these approaches. CAT MANAGER™ provided valuable insights to the trade-offs between approaches and made analysis faster, easier and interactive.
- Regular measurement of catalyst activity provides important information for the model and will enhance predictive capability of the model. Thus, having such a computer model is not a substitute for a regular catalyst testing. The model and the testing program enhance one another - with the testing providing useful information for the model and the model using that information as input for testing possible future scenarios.